The COVID-19 Pandemic Impacting Household Food Dynamics: A Cross-National Comparison of China and the U.S.

Zhengxia Dou^{1*}, Darko Stefanovski¹, David Galligan¹, Margaret Lindem², Paul Rozin³, Ting Chen^{4*}, and Ariana M. Chao⁵

¹ University of Pennsylvania School of Veterinary Medicine

² University of Pennsylvania Libraries

³ University of Pennsylvania School of Arts and Sciences

⁴ Zhejiang Gongshang University

⁵ University of Pennsylvania School of Nursing

* Corresponding authors

Abstract

This cross-national survey-based study examined in real time how the COVID-19 pandemic impacted food-centric matters in 1,732 Chinese and 1,547 U.S. households during the stay-at-home directives. Both cohorts reported increased efficiency in use of food, families spending more time cooking and eating together, and more prudent use of food with less waste. Food purchasing patterns shifted from frequent trips to the store to dramatic increases in online ordering. A small proportion (11% Chinese, 2% U.S. respondents) reported clinically significant weight gains of >4.5 kg. Household food insecurity worsened, with large increases in people worrying about or experiencing food shortage. Collective grocery-shopping experience by survey respondents indicated that the functional stability of food supply systems remained steady. All food types were somewhat available, except for noticeably higher prices widely reported by the Chinese cohort. This study offers insights into future food patterns and sheds light on long-term questions for additional research about how people make decisions and food behavioral changes at times of crisis and the consequences thereafter.

Introduction

COVID-19, first documented in China in December 2019¹, has since spread rapidly around the globe. Stay-at-home orders and isolations have been in effect worldwide in an effort to slow down the spread of the disease. As a result, large portions of the population have stayed home and numerous businesses including restaurants and eateries have closed or suspended services. Caught in the crisis, poorly prepared, and homebound for weeks or months, how did people fare in sourcing food and keeping their families fed? How did household-level food security (or insecurity) change during the crisis? Changes in food purchasing and eating patterns may also be related to weight change, with several popular media outlets referring to a “quarantine 15.” Growing media attention also highlights incidents of food flow disruption due to the pandemic, from vegetables rotting in fields and milk being dumped, to food processing facilities running short of workers due to the disease, to panic-buying activities occurring at retail stores. Strains on multiple points of the food supply chain could affect food availability and prices at grocery stores, ultimately impacting people at the receiving end^{2,3}. With the food system subjected to a ‘perfect

storm' because of the COVID-19 pandemic, what insights may be drawn from people's experience at the market-consumer interface regarding the integrity and resilience of the food system?

This study aims to address those critical issues by examining the food experience of Chinese and U.S. households during the pandemic through real-time data collection using convenience and snowball sampling methods. Our primary objective was to understand the impacts of the pandemic on household food dynamics, such as food purchasing and eating behavior, aspects of food security issues, as well as stress and self-reported body weight change. The secondary objective was to assess food supply system stability during the pandemic from the viewpoint of grocery shoppers. China and the U.S. are the largest countries most severely impacted by the COVID-19 pandemic as of mid- to late-April, 2020 (when the survey was conducted). Examining people's food experience in these countries can help us better understand the 'food-print' of the COVID-19 pandemic. Such understanding is critical for developing innovative policies and mitigation strategies toward a better and more secure food future. Patterns derived from the survey can inform additional research for determining long-term consequences. Lessons drawn from the survey cohorts with further investigations in the U.S. and China, two countries that feature distinct food cultures with different food systems, may be applicable elsewhere.

Results

Characteristics of the U.S. and Chinese cohorts

Valid survey respondents totaled 1,547 in the U.S. for the collection period of April 17-27, 2020 and 1,732 in China (collection April 22-27). Characteristics of the two cohorts are presented in Supplementary Table 1. At the time of the survey, the Chinese respondents had stayed at home for about 7.5-10 weeks; 62.4% had household member(s) losing income because of the pandemic. In comparison, the U.S. respondents had stayed at home for 4-6 weeks; 35.7% had household member(s) losing income. A greater proportion of the U.S. cohort reported that household members tested COVID-19 positive (0.41%) or had COVID-19-like symptoms (11.4%), compared to the Chinese cohort (0% and 1.99%). Of other demographic parameters, the U.S. respondents consisted primarily of women with age groups more or less evenly distributed, whereas the Chinese cohort was younger with a narrower gender gap (Supplementary Table 1, Fig. 1). It is also

noteworthy that the majority of the U.S. cohort (>70%) were in charge of household grocery shopping or meal planning/cooking (Supplementary Table 1), whereas the Chinese cohort had about 1/3 indicating this role.

Household food dynamics

Food sourcing changed dramatically during the pandemic, consistently for both cohorts. First, restaurant food ordering for take-out or delivery during the pandemic decreased in frequency (Supplementary Fig. 1a). Money spent on such food had the same pattern (Supplementary Fig. 1b). Second, the vast majority (74% for both cohorts) reported making fewer grocery-shopping trips during the pandemic than before (Supplementary Fig. 2). Meanwhile, online grocery shopping for delivery or curbside pickup became popular, about 1/3 of U.S. respondents reported doing so for the first time and 1/3 of the Chinese cohort reported community group-ordering for delivery (Fig. 2). Many people in the Chinese and U.S. cohorts reported purchasing extra amounts of various foods when grocery shopping (Supplementary Fig. 3).

Food-use behavior and perceptions changed, with both cohorts valuing food more during the pandemic than before. For example, many reported throwing away less food and for various reasons (Supplementary Table 2). In modern societies, food wastage can be reduced but total elimination is unlikely^{4,5}. For the survey respondents in both countries, spoiled fruits and vegetables topped the list of foods thrown away during the pandemic (Supplementary Table 3). This may be attributed to the extra-quantity purchases as well as the perishable nature of fresh produce. In line with the heightened awareness of food being precious, most U.S. and many Chinese respondents indicated making a second meal or snack of leftovers from restaurant food, as well as being more prudent in meal planning or spending less money on meals (Supplementary Table 2).

Importantly, a great many respondents indicated cooking home-meals more often (62% U.S., 60% China) and household members spending more time cooking or eating together (48% U.S., 73% China) (Supplementary Table 2). Meanwhile, use of ready-to-eat food items, such as frozen dinners, was less frequent. The vast majority indicated no change regarding types of food consumed during the pandemic as compared to before, although the number of people reporting

eating more of various foods exceeded those reporting eating less (Supplementary Fig. 4). By and large, changes in household food dynamics and the food attitudes of survey respondents were mostly positive/desirable, with patterns consistent for both the U.S. and Chinese cohorts. Some of the changes may persist, as about half of each cohort indicated that the pandemic might have changed how they will treat/handle food in the future (Supplementary Table 2).

Household food insecurity

The pandemic worsened household food insecurity (Table 1). Among U.S. respondents, over 10 times more people reported having worries about the ability to feed themselves or household members during the pandemic compared to before (509 vs. 45 respondents). Twice as many people indicated skipping a meal or going to bed hungry due to food shortage (33 vs. 16). Fortunately, having access to free foods from government or charity organizations, for the households in general (91 entries) or for school children (112 entries) in particular, helped relieve household food shortage during the pandemic. With the Chinese respondents, food insecurity situation worsened but to a lesser extent than the U.S. cohort (Table 1). Notably, households that were food insecure were in the lowest income category (<\$25,000 per U.S. household, <50,000 YMB per Chinese household) or had family members who lost income during the pandemic (Table 1). There is a need for rapid mobilization of effective intervention mechanisms to avert food shortage and to protect those who are most vulnerable at times of crisis like COVID-19 (see more in Discussion).

Food-mind-body

The pandemic brought abrupt and unimaginable interference to people's lives. In these challenging times, both cohorts found solace in food. About 70% of both cohorts indicated food being a pleasure/comfort element, a stress reducer, and a way to cope with boredom during the pandemic. Still, the U.S. respondents were bearing considerable stress (Table 2): about 30% indicating “rather much” or “very much” stress. In contrast, the Chinese cohort had just 7% indicating “rather much” or “very much” stress whereas 61% indicating “only a little” or “not at all” (Table 2). Level of stress was associated with age, household income level, and family members losing income during the pandemic (Supplementary Table 4).

Regarding body weight change (Table 2), the highest proportion of each cohort (39.5% U.S., 46.5% China) reported no change in weight; for the remainder, people reporting weight gains outnumbered those reporting weight loss. What differentiated the two cohorts was a greater extent of weight gain with the Chinese respondents, 11% gaining >4.5 kg (10 pounds) and 14% gaining 2.3-4.5 kg (5-10 lbs). In comparison, only 2% of the U.S. cohort reported gaining >4.5 kg and 11% gaining 2.3-4.5 kg. Weight change was related to stress level; association with age or income level was inconsistent for the two cohorts (Supplementary Table 4). Decreased physical (exercise) activities were reported by a large portion of each cohort (43.3% U.S., 47.8% China; Table 2).

Food supply and availability

The COVID-19 pandemic is a test for the functional stability of food supply systems. The survey asked what people experienced regarding food availability and choices when grocery shopping (shelf-empty, limited choices, store limited how much one could buy, compared to fully stocked) for nine food types (animal source food, fresh produce, processed foods, etc.) as well as two types of beverages. According to the U.S. respondents, most foods were available but many had limited options (Fig. 3a); reports of empty shelves were generally low (<10% of respondents) except for rice/flour/dried beans and manufactured grain products, for which 26.8% and 20.3% of respondents encountered empty shelves, respectively. Results from the Chinese cohort show that by and large, all food types were well stocked (Fig. 3b), with some choice limitations but relatively fewer shelf-empty reports. Food availability scores are >2 (U.S.) and >3 (China) for all food categories (Supplementary Table 5), indicating that all food types were somewhat available.

Food prices held steady based on the experience of the U.S. cohort (Fig. 4a); 70-90% of the respondents reported no price change, although 25.6% reported noticeably higher prices for meat/fish/eggs. Results from the Chinese cohort indicated price volatility; noticeably higher prices were reported by many for nearly all food types. About half of the Chinese cohort reported noticeably higher prices especially for meats/fish/eggs, fruits, and vegetables (Fig. 4b).

To gauge people's general confidence in food supply security, we asked "how did you feel about food supply and availability in your area or the nation in general". The U.S. cohort exhibited a dramatic shift from broadly optimistic (29%) or not concerned (54%) before pandemic, to the vast

majority (74%) being somewhat concerned or very concerned since the pandemic (Fig. 5a). In contrast, nearly 90% of the Chinese respondents indicated a high level of confidence (optimistic or not a concern) before and during the pandemic (Fig. 5b). Age, income level, and loss of income by household members during the pandemic were associated with the confidence of the U.S. but not the Chinese cohorts (Supplementary Table 5).

Discussion

The impact of the COVID-19 pandemic on food-centric matters was most acutely felt by the U.S. and Chinese families with the lowest income or those who had household members losing income during the pandemic. Deterioration in household food security was reflected by large increases in people of the U.S. cohort worrying about being able to feed their families as well as indications of food shortage in homes. According to Feeding America (a U.S.-based organization with a national network of >200 food banks providing food assistance to those in needs, pandemic or not), people seeking for food assistance increased 70% during the pandemic⁶. How to build the resilience of those most vulnerable and food insecure households and to avert food shortage at times of crisis remains a global as well as local challenge.

The positive changes of increased efficiency in use of food and families spending more time cooking and eating together are in part direct consequences of the stay-at-home orders, as individuals may now have more disposable time to spend on food preparation and less eating out or ordering in. Positive food attitudes in more prudent use of food with less wastage may be attributed to heightened awareness of food being in limited supply, close encounter and personal experience of choice limitations at food stores, as well as uncertainties people were facing regarding the trajectory of COVID-19 and food availability future. The durability of these positive changes and how widespread the phenomenon might be across large populations deserve further study. Pandemic or not, the world must find ways to feed the growing populations more sustainably⁷. Reducing food loss and waste throughout the food chain, particularly at the consumer level, is paramount⁸. Finding ways to sustain the positive change and to broaden relevant reach is important.

Despite widespread media reports of the “quarantine 15”, most survey respondents indicated no change in their weight. However, some reported clinically significant weight gains of greater than 4.5 kg in a short period of time. This group of individuals who rapidly gained weight may constitute a higher risk group that may benefit from targeted diet and exercise counseling. Some of them might have previously been on diets but with their routines drastically altered due to the pandemic. This entails further study.

The food supply systems apparently retained its integrity and functionality, more so in China (in terms of choice and availability) than in the U.S., based on the collective grocery experience of survey respondents. But the collage of snapshots provided by survey respondents revealed caveats and constraints, for instance, choice limitation and price volatility. Modern food supply chains are complex with many actors, moving parts, and connecting points^{9,10}. At times of crisis like the COVID-19 pandemic, rapid response and quick activation of intervention mechanisms at the national scale require flexibility in rule- and regulation-decision changes as well as adaptable implementation at business operations. For example, to divert food previously purposed for bulk distribution (schools, restaurants, etc.) to retail channels now requires government approval of labeling and packaging changes as well as execution capacity at packaging facilities⁶. In fact, during the pandemic, many entities worked in partnership to overcome barriers, bridge gaps, and alleviate the shock and smooth the flow of foods. Further work is needed to systematically examine what worked, where things went wrong, and what new mechanisms and strategies are needed to boost the resilience of the food systems toward a better and more secure food future. It is also interesting to note that how the phenomenon of online grocery-shopping will evolve post-pandemic may have important ramifications on matters pertaining to the infrastructure of the retail sector, their service mode, food safety and public health. Further investigation is warranted.

This study, through the lens of thousands of U.S. and Chinese respondents, describes the food-print of the COVID-19 pandemic in multiple dimensions. Many changes occurred involving household food dynamics with patterns consistent in both cohorts despite underlining differences in food culture and eating habits as well as demographic characteristics. Considerable differences between the food systems regarding food supply stability (availability and prices at the market-

consumer interface) may be related to a variety of factors, such as food sourcing (importation), regulative measures and flexibility, distribution means and channels and their adaptability, as well as the scope and efficacy of top-down interventions at times of crisis, among other things. Differences in characteristics of the two cohorts might have had important implications for how people have responded to the crisis as well as to survey questions. For example, the young majorities of the Chinese cohort might be less prone to stress or life-changing uncertainties; instead they might have derived more joy from delicious home-made meals while staying with parents during the pandemic. Furthermore, people's resilience at times of crisis can be deeply rooted in historical, societal, and cultural background as well as personal traits and experiences; exploring such elements and their connections and influences would be of great interest.

Using convenience-snowball sampling for real-time data collection, we were able to capture people's food experience as they encountered it amid the pandemic while staying-at-home. We acknowledge potential limitations of the methodology, such as sampling is not representative and findings are not generalizable^{11,12}. Meanwhile, we recognize that methodology-related issues might not fit the classic definition, because the pandemic's impacts are so widespread and pervasive and essentially encompassing everyone in the societies. We plan to conduct additional work with more rigorous and strategic sampling for better representation of the population, and findings from the present study offers insight into and shed light on long-term questions, to be explored in further study, about future food patterns and how people make food behavior changes at times of crisis and relevant consequences thereafter.

Methods

Survey design

The survey consisted of 53 questions (single or multiple, numeric or descriptive choices), to collect data on: (i) demographics of respondents; (ii) parameters reflecting household food dynamics (food purchasing, at-home food related activities, and food-use behavior); (iii) household-level food insecurity parameters; (iv) food supply and availability indicators in marketplaces as experienced by survey respondents; and (v) other relevant matters (stress level, body weight change, etc.). The survey contained no identifier items, such as name, address, etc. The study was

deemed exempt from requiring human subjects approval by the Institutional Review Board of the University of Pennsylvania.

The Chinese-language version was identical in content to the original (English) version except for a few items that were adapted to be applicable to Chinese participants, for example, race/ethnicity choices, household income range, height (in meters instead of feet) and weight (in kilograms instead of pounds). The two versions were hosted on the same internet platform.

Survey distribution

After pilot testing, the cross-sectional survey was disseminated online. Initial distribution of the English version was via the researchers' professional and personal networks and their home institutions. Broader dissemination was attained via snowballing through individuals' social media postings. In China, distribution was achieved by the researchers soliciting assistance from their professional colleagues as well as personal contacts inside China; those contacts in turn spread the word via their networks. In particular, a number of university faculty members recruited their current as well as former graduate students, who were off campus and widely scattered across the country during the pandemic, to participate in the survey as well as further dissemination.

Cross-sectional data collection started on April 17, 2020 in the United States, April 22 in China. The number of daily responses spiked within 24 hours in each country and slowed down substantially within 3-5 days. The slowing-down was more rapid in China than in the U.S. Data collected during April 17-27 in the U.S. and April 22-27 in China were extracted for analysis in this study. Valid responses (answering at least two survey questions) totaled 1,547 from 705 zip code regions in the U.S. and 1,732 from 30 out of 34 Provincial-districts in China.

Data analysis

Raw data were exported to and analyzed in Stata (Stata Corp., College Station, TX). All analyses were conducted with two-tailed tests of hypotheses and a p-value < 0.05 as the criteria for statistical significance. Descriptive analyses include computation of means (with 95% confidence intervals [95%CI]), standard deviations, medians, interquartile ranges (IQR) of continuous variables and tabulation of categorical variables. Frequency counts and percentages were used for categorical

variables. Inference statistical analyses were conducted using the chi-square test for comparison of categorical variables and ANOVA or t-test for continuous outcomes.

References

1. World Health Organization (WHO). Novel Coronavirus (2019-nCoV) SITUATION REPORT-1 JANUARY 2020. WHO, United Nations Economic and Social Council, Geneva, Switzerland (2020).
2. World Economic Forum (WEF). What past disruptions can teach us about reviving supply chains after COVID-19. WEF, Cologny-Geneva, Switzerland (2020).
3. World Bank. The economic impact of the 2014 Ebola epidemic. The World Bank, Washington, D.C. (2014).
4. Papargyropoulou, E., Lozano, R., Steinberger, J.K., Wright, N., bin Ujang, Z. The food waste hierarchy as a framework for the management of food surplus and food waste. *J. Cleaner Prod.* **76**, 106-115 (2014).
5. Quested, T. & Murphy, L. Household food and drink waste: A product focus. Final Report. Waste & Resources Action Programme (WRAP), Banbury, UK (2014).
6. Bipartisan Policy Center (BPC). BPC Food Summit. Available at: <https://bipartisanpolicy.org/event/bpc-food-summit/> (2020).
7. Food and Agriculture Organization of the United Nations (FAO). The state of food and agriculture 2019: Moving forward on food loss and waste reduction. FAO, Rome (2019).
8. Dou, Z. et al. Assessing U.S. food wastage and opportunities for reduction. *Global Food Security* **8**, 19-26 (2016).
9. Cutter, S.L. The perilous nature of food supplies: Natural hazards, social vulnerability, and disaster resilience. *Environ. Sci. Policy Sustain. Dev.* **59(1)**, 4-15 (2017).
10. Umar, M., Wilson, M., Heyl, J. Food network resilience against natural disasters: A conceptual framework. *SAGE Open* **7(3)**, article no. UNSP 2158244017717570 (2017).
11. Bornstein, M., Jager, J., Putnick, D.L. 2013. Sampling in developmental science: Situations, shortcomings, solutions, and standards. *Devel. Rev.* **33**, 357-370 (2013).
12. Etikan, I., Musa, S.A., Alkassim, R.S. Comparison of convenience and purposive sampling. *Am. J. Theor. Appl. Stat.* **5(1)**, 1-4 (2016).

Acknowledgements

Zhenling Cui and Chong Wang of China Agricultural University, Xiaojie Liu of Chinese Academy of Sciences, Diming Wang of Zhejiang University, Yaofeng Yuan of Fuzhou University, Zimen Wei of Northeast Agricultural University, Xinping Chen of Southwest University, Xixia Dou and many other individuals helped distribute survey in China. John Toth performed some literature research and edited the manuscript. Ting Chen is a visiting scholar supported by a China Scholarship Council grant. Ariana M. Chao was supported, in part, by the National Institute of Nursing Research of the National Institutes of Health under Award Number K23NR017209. Zhengxia Dou received research support from the Global Engagement Fund, University of Pennsylvania.

Author contribution

All authors were involved in survey design, development, and distribution. ML helped with initial literature search; she also shaped the language of the questionnaire to fit grade level 8-9 and up. DS took charge in survey platform logistics and conducted data analysis; TC performed data management. TC and ZD coordinated survey dissemination in China. ZD directed the study and wrote the manuscript. AC made major contributions in study design and manuscript revision. All authors reviewed and approved the manuscript prior to submission.

Corresponding authors

Zhengxia Dou, douzheng@vet.upenn.edu

Ting Chen, chenting_15@zjgsu.edu.cn

Competing interests

The authors declare no competing interests.

Tables and Figures

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Fig. 4. Food price change during as compared to before the COVID-19 pandemic, according to U.S. (a) and Chinese (b) survey participants when grocery-shopping.

Fig. 5. Perception of food security during as compared to before the COVID-19 pandemic.

(Supplementary Tables and Figures are in a separate file.)

Table 1. Household food insecurity situation worsened during the COVID-19 pandemic. There were increases in people who reported worries about or experiencing of food shortage since the pandemic compared to before. Most of those people were in the lowest income group or had household member(s) losing income during the pandemic. More than 10% of all survey participants reported having access to free food from government or other organizations for families or for school children during the pandemic.

	United States			China		
	N	Lowest income ¹	Lost income ²	N	Lowest income ¹	Lost income ²
Worries about not being able to feed family before pandemic	45	13 (28.9%)	27 (60.0%)	188	51 (27.1%)	140 (74.5%)
Worries about not being able to feed family since pandemic	507	39 (7.7%)	213 (42.0%)	360	92 (25.6%)	265 (73.6%)
Skipping a meal or going to bed hungry due to food shortage before pandemic	16	6 (37.5%)	11 (68.8%)	81	34 (42.0%)	63 (77.8%)
Skipping a meal or going to bed hungry due to food shortage since pandemic	33	4 (12.1%)	17 (51.5%)	52	23 (44.2%)	46 (88.5%)
Access to food from government or charity organization during pandemic	91	5 (5.5%)	41 (45.1%)	124	29 (23.4%)	88 (71.0%)
Access to free meals provided to school children during pandemic	112	4 (3.6%)	41 (36.6%)	57	15 (26.3%)	36 (63.2%)

¹ <\$25,000 per U.S. household, <50,000 RMB per Chinese household.

² Household member(s) lost income during the COVID-19 pandemic.

Table 2. Stress level and body weight change during the COVID-19 pandemic as reported by U.S. and Chinese participants. All analyses were conducted with two-sided tests of hypotheses and a p-value < 0.05 indicating statistical significance.

	United States	China	p-value for U.S. vs
	No. (%)	No. (%)	
“Do you feel stressed these days”?	N=1327	N=1611	P<0.001
Not at all	93 (7.0%)	546 (33.9%)	
Only a little	362 (27.3%)	515 (32.0%)	
To some extent	459 (34.6%)	440 (27.3%)	
Rather much	263 (19.8%)	83 (5.2%)	
Very much	150 (11.3%)	27 (1.7%)	
“What has happened to your weight during the pandemic”?	N=1326	N=1615	P<0.001
Gained >10 lb (4.5 kg)	27 (2.0%)	173 (10.7%)	
Gained 5-10 lb (2.3-4.5 kg)	143 (10.8%)	221 (13.7%)	
Gained <5 lb (2.3 kg)	267 (20.1%)	307 (19.0%)	
Stayed the same	523 (39.4%)	752 (46.6%)	
Lost <5 lb (2.3 kg)	186 (14.0%)	78 (4.8%)	
Lost 5-10 lb (2.3-4.5 kg)	61 (4.6%)	29 (1.8%)	
Lost >10 lb (4.5 kg)	14 (1.1%)	10 (0.6%)	
Don’t know	105 (7.9%)	45 (2.8%)	
“During the pandemic, have your physical activities	N=1325	N=1610	P<0.001
Increased	391 (29.5%)	325 (20.2%)	
No change	360 (27.2%)	516 (32.1%)	
Decreased	574 (43.3%)	769 (47.8%)	

Fig. 1: Age group distribution of survey participants. The U.S. cohort (N=1547) was more or less evenly distributed whereas the Chinese cohort (N=1732) consisted of proportionally more people in the younger range of ages.

Fig. 2. Online grocery-shopping increased dramatically during the COVID-19 pandemic. Many reported ordering groceries online for delivery or curbside pickup for the first time. About 1/3 of the Chinese cohort reported community-based group ordering for delivery.

Fig. 3. Food availability as experienced when grocery-shopping by survey respondents from U.S. (a) vs. China (b). Foods were categorized into 9 groups. Two types of beverages were also included in survey questionnaire. Food availability was more variable for the U.S. than the Chinese datasets ($P<0.001$).

Fig. 4. Food price change during as compared to before the COVID-19 pandemic, according to U.S. (a) and Chinese (b) survey participants when grocery-shopping. Proportionally, noticeably higher prices were reported by more Chinese than U.S. participants ($P<0.001$) for all food types, particularly meats/fish/eggs, fruits, and vegetables.

Fig. 5. Perception of food security during as compared to before the COVID-19 pandemic. The U.S. cohort exhibited a sharp decrease in confidence in food supply and availability in their area or the nation in general (a), whereas the Chinese cohort retained their confidence (b).